DOCUMENT RESUME

ED 388 281 IR 017 430

AUTHOR Oliver, R.; Reeves, T.
TITLE An Investigation of the Use of Telecommunications To Increase Equity and Access to Education in Rural Schools in Western Australia.
PUB DATE 94
NOTE 7p.; In: Educational Multimedia and Hypermedia, 1994. Proceedings of ED-MEDIA 94--World Conference on Educational Multimedia and Hypermedia (Vancouver, British Columbia, Canada, June 25-30, 1994); see IR 017 359.
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Access to Education; *Computer Uses in Education; *Distance Education; Elementary Secondary Education; *Equal Education; Foreign Countries; *Rural Schools; Telecommunications; Use Studies
IDENTIFIERS *Australia (Western Australia); *Telematics

ABSTRACT

The provision of diverse and specialized educational programs to students in rural schools is hindered by many factors associated with the demography and sociology of the schools. This paper reports on a project in Western Australia called the PCAP (Priority Country Access Program) Project, that used audiographic systems to enhance the equity and access to schooling for students in rural schools. Telematics is a generic term that describes real-time electronic communications; one of the principle strengths of Telematics for distance education programs is its capacity to mimic conventional face-to-face teaching through a blend of interactivity and independence. There are a number of strategies that have been created as a means to judge the potential of telelearning courses that can be applied against Telematics to test its robustness and integrity as an alternate delivery platform. This study used qualitative data from multiple sources, including interviews, questionnaires and documentation. Telematics teaching was judged to have been successful and cost-effective by a large majority of the participating schools, teachers and students in four rural regions. As an instructional delivery platform, it is flexible and efficient, enhancing student interest and motivation, student/teacher and student/student interactivity, student autonomy, and enabling the delivery of specialist programs without a specialist teacher. (Contains 18 references.) (AEF)

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An Investigation of the Use of Telecommunications to Increase Equity and Access to Education in Rural Schools in Western Australia

R. OLIVER
Department of Library and Information Science
Edith Cowan University, Bradford St, Mt Lawley, 6050, Western Australia.
E-Mail: r.oliver@cowan.edu.au

T. REEVES
Department of Instructional Technology
College of Education, The University of Georgia, 607 Aderhold Hall, Athens, GA 30602-7144, USA
E-Mail: treeves@moe.coe.uga.edu

ED 388 281

Abstract: The provision of diverse and specialist educational programmes to students in rural schools is hindered by many factors associated with the demography and sociology of the schools. This paper reports on a project in Western Australia that used audiographic systems in an attempt to enhance the equity and access to schooling for students in rural schools. Schools collaborated within clusters and used telecommunications systems to create virtual classrooms within which priority educational programmes were delivered. The success of the project and associated factors are discussed in this paper.

Introduction

Western Australia is the largest of the Australian states with a total area in excess of 2,500,000 square kilometres. Ninety percent of the population live in and around the capital city Perth in the South-West. The remaining ten percent of the population live throughout the rest of the state and this demography poses special problems for the delivery of education. In the larger regional centres, there are usually educational opportunities for all children to study at school to the Year 12 university entrance level, however there are frequently restrictions in subject choice that students can make. In smaller regional centres, education opportunities will range from schooling to the Year 10 level, the compulsory schooling age, through to no formal schooling at all. A comprehensive distance education programme is run in the state to cater for students who do not have access to formal schooling. Students can study in a correspondence mode in any grade from pre-school to Year 12.

There are a number of disadvantages apparent in the educational opportunities received by students in remote and rural schools in this state. There is a reduced retention rate among rural students staying on at school to complete Year 12. Secondary school students in smaller country schools are disadvantaged in the subject choices that they can make. The bulk of the beginning teachers (67%) in the state take up their initial teaching positions in country schools. In an attempt to improve the disadvantages of equity and access suffered by rural students, the Ministry of Education in Western Australia has undertaken a number of projects through its Social Justice branch using innovative applications of information technologies. This paper reports on an evaluation undertaken by the authors to assess the outcomes from such a project that sought to use *Telematics* to improve rural secondary students' equity and access to schooling.

Telematics

Telematics is a generic term that describes real-time electronic communications. In this project, the telematics system that was employed involved an audiographic link between teachers and students. Using the software package, Electronic Classroom (Crago, 1992), teaching and learning is achieved through a telecommunications link between computers and an audioconferencing medium using telephone communications. Standard telephone connections are used to connect the teacher and students with two-way voice and graphic communications. Both the teacher and students view the same information on their computer screens which are used as the blackboard while the two-way audio communication is used for the normal student-teacher

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interaction. A typical setting sees a teacher connected to several remote sites and the establishment of a simulated face-to-face environment through the technology.

The development of Telematics technology in recent years has considerably increased the educational prospects of students in local rural schools. This technology provides the means to deliver interactive instructional programmes across a number of remote and physically isolated sites. It appears to be an ideal medium for the delivery of the specialist programmes. Although this technology can provide such a service, it remains to be seen whether the application will achieve its full potential and provide a real solution to a pressing and serious problem.

Interactivity and Independence. One of the principal strengths of Telematics as a delivery platform for educational programmes in rural schools, is its capacity to mimic conventional face-to-face teaching. Traditionally, the two attributes of face-to-face teaching that are absent from distance education are interactivity and independence (Juler, 1990). All classroom teaching and learning is based on a degree of interactivity between teacher and student. The teacher plays a pivotal role in not only providing instruction, but also in motivating, leading and guiding students. At the same time, schools provide an organised and rigid framework for the learning programme. While schools can therefore be characterised by high levels of interaction and low levels of learner independence, in differing forms of distance education, interactivity and independence tend to be traded off each against the other. Figure 1 shows how these entities compare and contrast across the different modes of distance education (Garrison, 1985).

In many distance education modes and open learning settings, high levels of both interactivity and independence are sought after (Haughey, 1991). These can be achieved for example, through the use of pre-prepared learning materials using alternative forms of learner interaction, including computer based learning materials. For the provision of specialist distance education programmes in a school setting, the preferred blend would appear to involve a high level of interactivity with lower levels of independence. This blend is a close match to traditional classroom teaching and is evident in such delivery systems as interactive television and telelearning courses.

Telelearning. Telematics is a form of telelearning. Telelearning describes the technology that employs telecommunicationand computer mediated communications to create links between teachers and students (Nipper, 1989). Goldman & Newman (1992) describe a number of learning advantages to be achieved with this medium. Telelearning includes such applications as e-mail, audioconferencing and teleconferencing. These learning environments are characterised by active learning situations with student-initiated discourse using interactive communications. Research into the use of telecommunications and in particular, computer-mediated communications, frequently realise significant learning outcomes (Levin, Waugh, Chung & Miyake, 1992).

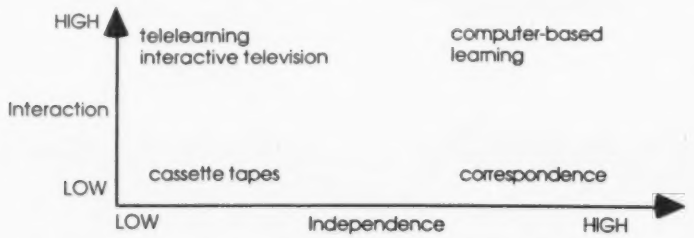

Figure 1
Interactivity and Independence across distance education delivery methods.

Telematics seems ideally suited to delivering specialist programmes into rural schools. Its form is an extension of audioconferencing, a powerful and popular delivery mode of the past twenty years. Audioconferencing provides an auditory link between the teacher and students by which information can be shared, critically analysed and applied in order to become knowledge in the mind of the learner. Audioconferencing is a cheap and effective delivery mode with proven advantages derived from the interaction that it enforces and supports (Garrison, 1990). Telematics or audiographics as it is commonly called, adds a visual link to strengthen and improve the quality of the audiconferencing interaction.

The Effectiveness of Telematics

There are a number of strategies that have been created as a means to judge the potential of telelearning courses that can be applied against Telematics to test its robustness and integrity as an alternative delivery platform (Stubbs & Burnham, 1990; Collis, 1993). The models that are suggested often differ in the contexts in which they are applied. Collis (1993) describes a strategy that reviews particular applications while Stubbs and Burnham (1990) describe a means to assess the technological dimensions of the application itself. When the criteria described by these strategies are applied to Telematics, few weaknesses appear to exist. Telematics encompasses a wide variety of communication paths, audio, visual and documentary. After training, the system is not judged by its users to be difficult to use. The technology provides a learning environment that approaches the realism of face-to-face better than most others and communications and interactions are instantaneous. It does not offer independence of time and place and thus may be unsuited to other forms of distance education. But as mentioned previously, this is not a requirement of the school based distance education programmes in which it is used, and as such is no impediment to its effective application.

The relative youth of Telematics as an instructional delivery system sees only low levels of previous research and investigation being reported. Audiographics technology has received very positive reviews from studies in the North American context. Positive findings have been reported from early studies in Canada and the USA (Frederickson, 1990). Identified outcomes have included strong attitudinal and motivational gains supporting enhanced learning environments. Several reports in the Australian context have confirmed the potential gains of the technology (eg. States, 1992; Rehn, 1992; McGregor, 1992). In assessing the value of technological applications to teaching and learning, we must be careful to avoid the "visionary" trap described by Collis (1993). This trap is encountered when one assumes because a project proceeds and happens as planned, this can be used as a measure of its success. Measures of success need to be empirically based and empirical evaluations of Telematics are only just happening.

Evans and Nation (1992) describe an empirical investigation into Telematics in Victorian schools. Their preliminary report suggests the need for some caution in embracing the technology as evidenced from some shortcomings and impediments identified in their research. Some of the factors that can limit the effectiveness of the teaching and learning environments are:

- the very high levels of preparation and planning that necessarily must accompany lesson delivery,
- the problems associated with establishing discipline and authority in the virtual classroom,
- technical problems that can arise, and
- the changes brought about to work practices.

A study of the use of Telematics among student-teachers (Stacey, 1994) describes some very positive outcomes achieved in a teacher education programme. Through the use of Telematics in a LOTE practicum environment (the teaching of languages other than English), the researchers identified a number of positive gains for both teachers and students through Telematics interactions. The researchers report such findings as;

- increased levels of student participation in lessons,
- increased use of oral language by teachers and students,
- the improvement of children's listening skills, and
- more flexible and cooperative learning environments.

Telematics has made significant in-roads in Australian distance education programmes in the past three years. The technology has proved itself to be robust and well able to support the educational applications in which it is used. While previous research has demonstrated the utility and efficacy of the technology, there is a need for research to further investigate factors influencing the effectiveness of the teaching and instructional applications.

The PCAP Project

The study that is described in this paper was undertaken as an evaluation of a large scale implementation of Telematics into rural schools in Western Australia, called the PCAP (Priority Country Areas Programme) Project. The stated aims of the project were to:

- increase the number of students in prescribed country areas completing a least twelve years of schooling,
- expand opportunities available to these rural school leavers,
- improve levels of student achievement,
- reduce incidence of gender bias in subject choice (particularly among students from low socio-economic backgrounds,

- increase opportunities for personal development through increased interaction with peers from broader cultural and socio-economic backgrounds.

Special funding was supplied by the Federal government to give states the opportunity to explore ways to improve equity and access to education in rural regions. Four regions in Western Australia were chosen to participate in the project after a submission process had been completed. These regions extended from the far North-West to the Southern regions. Within each region clusters of schools cooperated and collaborated to deliver educational programmes among themselves using Telematics.

The special funding provided all schools in the cluster with the required equipment to run Telematics courses and provided training and technical support to teachers in the rural schools. In the first phase of the programme, funding was provided to enable teachers to be released from normal duties to deliver Telematics programmes to other schools. It was planned that once schools and teachers had become familiar with the technology and its application, they would become self-sufficient and able to use the technology in subsequent applications without further financial support. Another purpose of this study was to determine whether the objective of self-sufficiency could be obtained and whether Telematics had the potential to significantly enhance the equity and access of rural schools to educational programmes.

The researchers used a multi-method technique of data gathering and analysis developed and applied in similar projects in the USA (Reeves, 1992). This technique was based on the work of Mark and Shotland (1987). The study used qualitative data gained from multiple sources including observation, interview, questionnaires and documentation and multiple perspectives, to enable validity and reliability to be maintained. The data gathering and evaluative process was built around the four stages of the process described by Collis (1993);

- gathering information about the intentions of the project,
- assessing logical contingencies,
- observing and measuring actual and contextual applications,
- assessment of incongruities between intended and actual occurrences.

The researchers travelled widely to visit the participating schools to discuss aspects of the project with the teachers, administrators and students. The teaching and learning processes were extensively observed to enable judgements to be made about the success of the project and factors that influenced the successes achieved.

Outcomes

The main purpose of the PCAP project was to provide an enhanced and broadened curriculum within rural schools that would contribute to post-compulsory (P/C) schooling programmes. In the Kimberley region, schools chose to use Telematics to deliver post-compulsory programmes while in the others, the schools implemented programmes among younger children that would lead to increased opportunities when they moved into the post-compulsory phase of their education. The curriculum areas that formed the PCAP project are shown in Table 1.

Table 1
The Curriculum Choices within the Regions

Region	Curriculum	Technology
Kimberley	Applied Computing (P/C) English as a Second Language (P/C)	Telematics
Geraldton	Maths, English, Social Studies Unit Curriculum	Telematics
Pilbara	Languages other than English Japanese	Telematics
Kalgoorlie	Languages for students at risk, English, Transition Mathematics	Telematics

A typical programme would see a selected teacher in one school prepare a teaching programme and curriculum materials for students enrolled in other schools in the region. Selected students would have some element of their school programme replaced by the Telematics programme. The lessons would be timetabled several times per week and conducted in the Telematics room through a system of audioconferencing and computer communications. The educational programmes prepared by the Telematics teachers would include activities for

students to complete outside class time together with assignment and project material. Students would work on these activities between lessons to prepare for further lessons and to practice and consolidate the content of previous lessons.

Telematics teaching was judged to have been very successful by a large majority of the participating schools, teachers and students. The delivery method worked well and was seen to be an effective way to deliver the specialist programmes into the rural schools;

- students enjoyed the format of the electronic lessons and looked forward to them,
- the interactivity between teachers and students and students and students enhanced the quality of the learning outcomes,
- students assumed high levels of responsibility for themselves and their work,
- the system enabled specialist programmes to be delivered to schools without specialist teachers.

There were varying levels of success achieved among the four projects and a number of key factors were observed to which the degrees of success could be attributed. The major influences came from the ways by which teachers used the technology in their teaching and learning and the manner in which the Telematics programmes were organised within and across the schools.

Instructional Strategies. Telematics is a technology that demands high levels of technical expertise from its users as well as the use of appropriate instructional strategies. All teachers in this project were experienced classroom teachers who had learned to use Telematics over a relatively short period of time. There were naturally many differences observed in the nature and format of the instructional programmes that each delivered. From observations and interviews, the researchers judged that the following aspects of the teaching and learning processes were significant factors in the successes (or lack thereof) achieved by the teachers;

- Levels of preparation and planning accompanying lesson delivery, including use of varying instructional formats and strategies, appropriate levels of student-initiated and independent-student activity, and discerning use of the technology matched to intended learning outcomes.
- The development of flexible learning environments to promote positive teacher-student relationships, open and comfortable classroom climates promoting student involvement and interaction. Activities that created and facilitated contact between the teachers and students to further develop relationships and interpersonal communications.
- Effective communications skills on the part of teachers enabling appropriate mixes of teacher-led and student-led communications to be supported.
- Strong administrative and teaching support at the receival school including established and consistent organisational systems.
- Strong technical skills on the part of teachers (and students).
- Constant evaluation and assessment on the part of the teachers on all aspects of the teaching and learning.

Organisation and Management. The success of the teaching was seen to depend not only on the quality of the lessons delivered by teachers but also on a myriad of other activities and supports influenced by the ways in which schools implemented and managed their Telematics programmes. The researchers identified factors at the school, regional and system level that impacted significantly on programme success. These included;

- At the *school level*, the setup and physical location of the equipment within schools, the level of supervision and coordination provided by teachers at the receival schools for the delivery programmes, and the extent and depth of the skills and expertise in Telematics across the curriculum areas and among staff.
- Within *regions*, the level of cooperation and collaboration in the planning and management of Telematics programmes undertaken within local clusters or groups of schools, the adoption of agreed policies and practices relating to programme delivery and receival, and the capacity of schools to exchange programmes and courses of instruction.
- At the *system level*, the provision of training and support programmes provided to support Telematics, the level of on-going research and development seeking ways and means to improve teaching and learning and the overall levels of computing skills and technology awareness among teaching graduates and teachers within rural schools.

A key indicator of the success of the project was the extent to which the schools acted in collaboration and cooperation to ensure the continuation of the programmes and to extend curriculum offerings and applications. Across all schools there was recognition of the strong need for educational programmes that enhanced the prospects of their students in post-compulsory schooling. Telematics was judged to be successful, cost-effective

and capable of delivering these programmes. By the end of the first year of the project, schools were required to fund their own programmes and innovative schemes and strategies were employed to achieve this;

- Larger schools with more flexibility in programme selection and organisation delivered concurrent programmes to face-to-face students and classes of students in remote schools,
- connections were made beyond regions to enable students within schools to join other Telematics programmes,
- collaborative programmes between schools were continued and resourced from school funds,
- school timetables and staffing arrangements across regions were reorganised to fit Telematics requirements.

Conclusions

In the local context, Telematics showed itself to be an ideal application of technology in response to an urgent educational problem. The technology itself was generally quite robust and reliable. As an instructional delivery platform, it is flexible and efficient and provides a number of key elements associated with effective teaching and learning. It demands reasonable levels of technical knowledge and expertise of the part of the users. The application is in its infancy and will obviously benefit from research and development activity into effective applications. From this study, it is evident that there are many factors that can influence the successful delivery of programmes through Telematics. Applications of the findings across local programmes will help to enhance the utility and efficacy of as an alternative delivery platform for rural school educational programmes. A key area for further research is the development of instructional strategies for the different curriculum areas to enable Telematics teaching to create learning environments that increase the students' level of participation as active and reflective learners. Our university is including Telematics as a component of its pre-service teacher education programme and is looking to establish a research direction in this field.

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